

finally brought to rest, while the sand of a modern beach may have been ground down by the waves of many successive geological periods.

Sand taken by Mr. Sorby from the old gravel terraces of the River Tay was found to be almost wholly angular, indicating how little wear and tear there may be among particles of quartz $\frac{1}{16}$ of an inch in diameter, even though exposed to the drifting action of a rapid river.¹¹³ Sand from the boulder clay at Scarborough was likewise ascertained to be almost entirely fresh and angular. On the other hand, in geological formations which can be traced in a given direction for several hundred miles, a progressively large proportion of rounded particles may be detected in the sandy beds, as Mr. Sorby has found in following the Greensand from Devonshire to Kent. In wind-blown sand exposed for a long period to drift to and fro along the surface the larger particles and pebbles acquire a remarkably smoothed and polished surface.

The occurrence of various other minerals besides quartz in ordinary sand has long been recognized, but we owe to the recent observations of Mr. A. B. Dick the discovery that among these minerals some of the most plentiful and most perfectly preserved belong to species that were not supposed to be so widely diffused, such as zircon, rutile, and tourmaline. He has found that these heavy minerals constitute sometimes as much as 4 per cent of the Bagshot sand of the older Tertiary series of the London basin.¹¹⁴ Felspars, micas, hornblendes, pyroxenes, magnetite, glauconite and other minerals may likewise be recognized. The remarkable perfection of some of the crystallographic forms of the minuter mineral constituents of certain sands has been well shown by Mr. Dick.

Varieties of river- or sea-sand may be distinguished by names referring to some remarkable constituent, *e.g.* magnetic sand, iron-sand, gold-sand, auriferous sand, etc.

Gravel, Shingle—names applied to the coarser kinds of rounded water-worn detritus. In Gravel, the average size of the component pebbles ranges from that of a small pea up to about that of a walnut, though of course many included fragments will be observed which exceed these limits. In Shingle, the stones are coarser, ranging up to blocks as big

¹¹³ See Book III. Part II. Section ii. § 3.

¹¹⁴ *Nature*, xxxvi. (1887), p. 91, *Mem. Geol. Surv. "Geology of London,"* vol. i. (1889), p. 523. Teall, "Microscopic Petrography," Plate xlv.